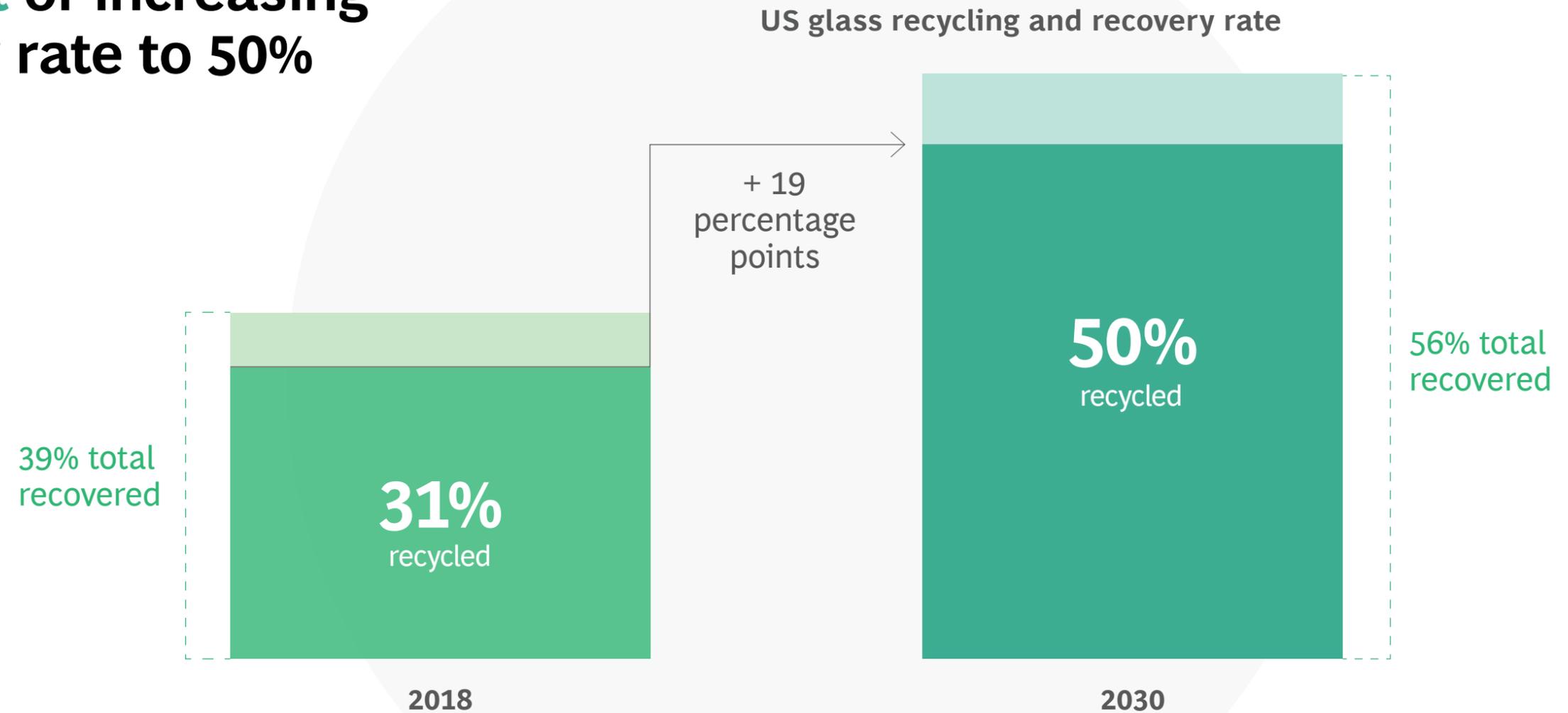




A Circular Future for **Glass**

A ten-year roadmap
to increase US glass recycling

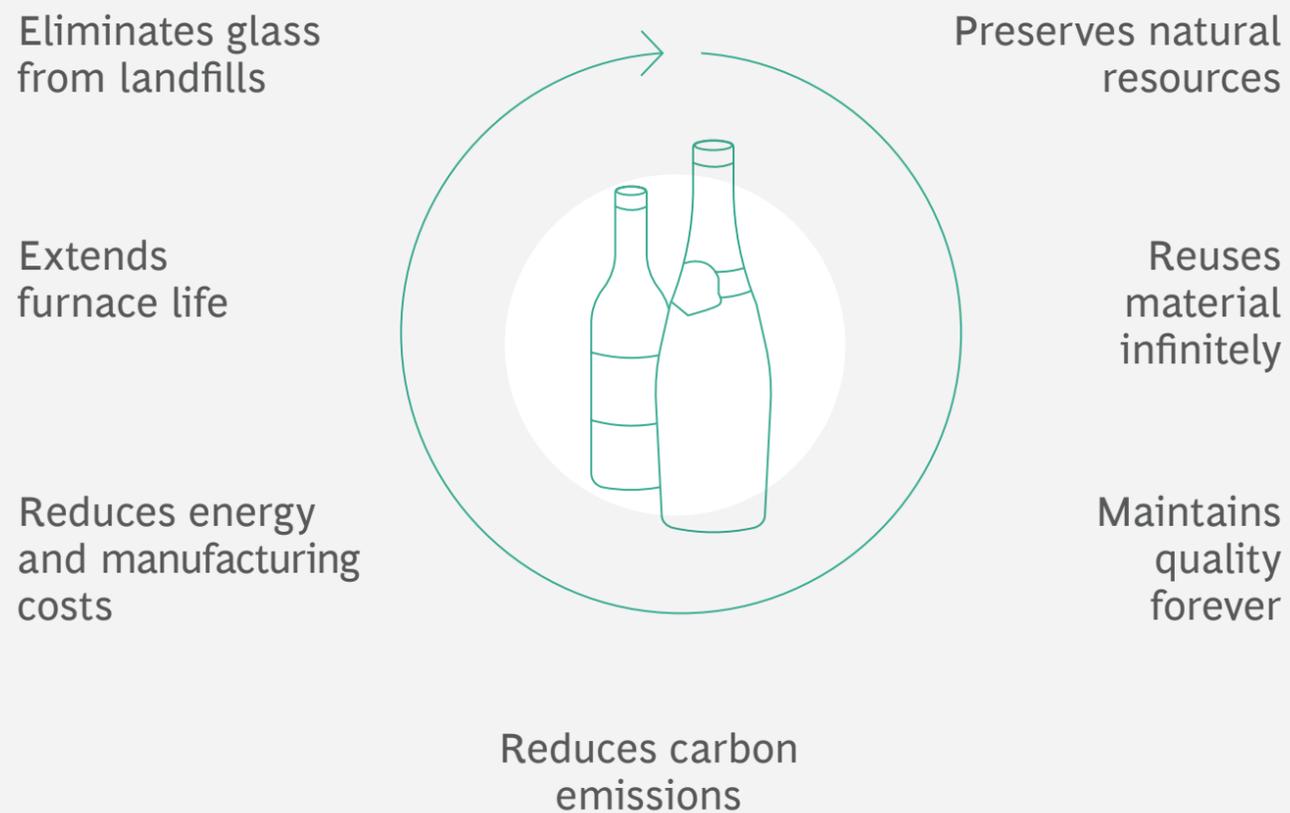
The glass container industry has set a **bold target** of increasing the US recycling rate to 50%



Sources: United States Environmental Protection Agency; Glass Packaging Industry (GPI); BCG.

Note: The 39% figure represents the rate of glass recovered (or collected), but some recovered glass is lost to landfills or as it moves along the recycling value chain, from sorting to processing to manufacturing. The remaining 31% is recycled into new containers. Some variability exists in how recycling rates are calculated across the US.

Improved US glass container recycling is an important goal

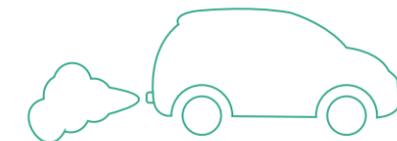


Sources: GPI; BCG.

Recycled materials are much more **environmentally friendly** than virgin materials



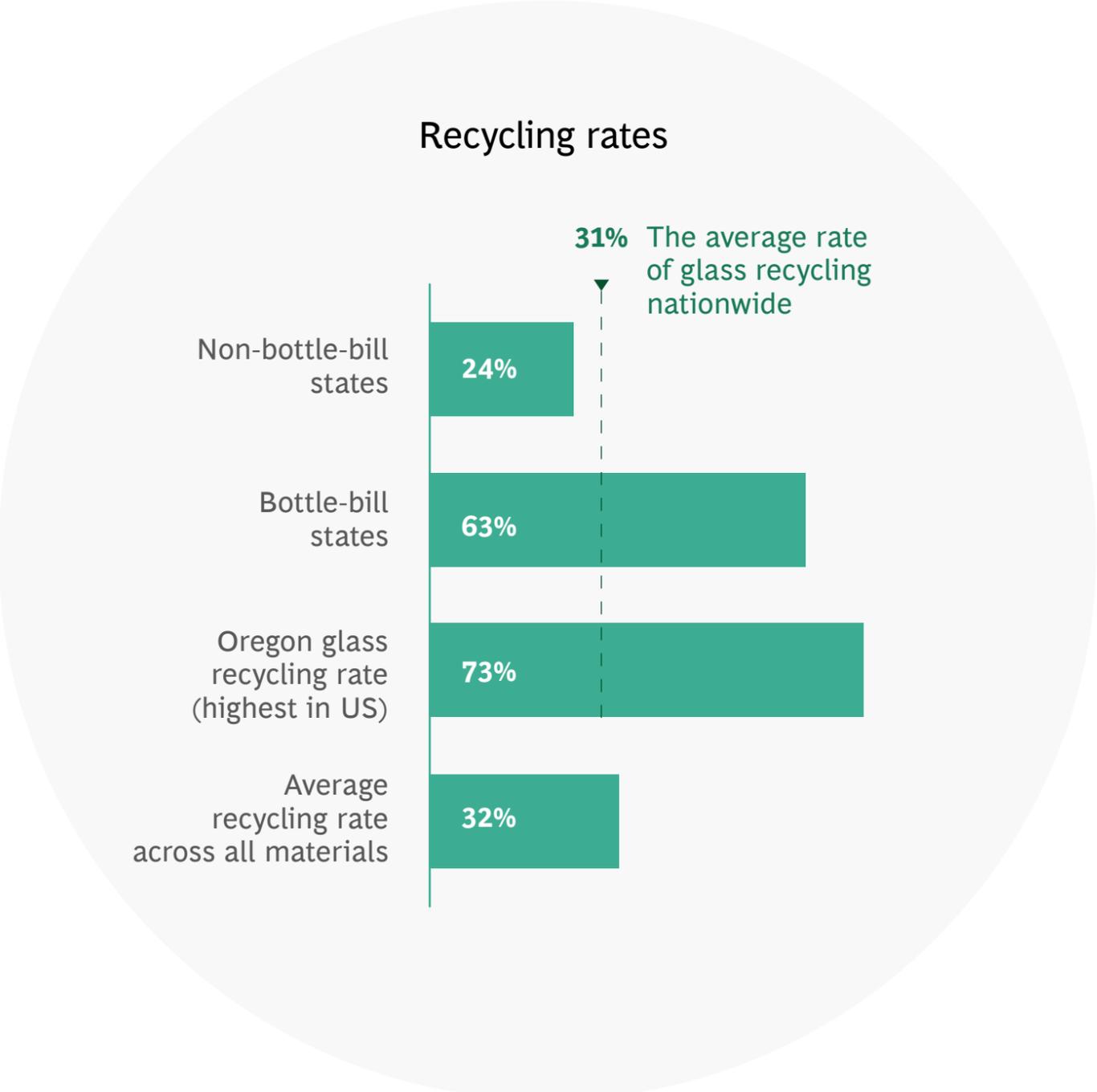
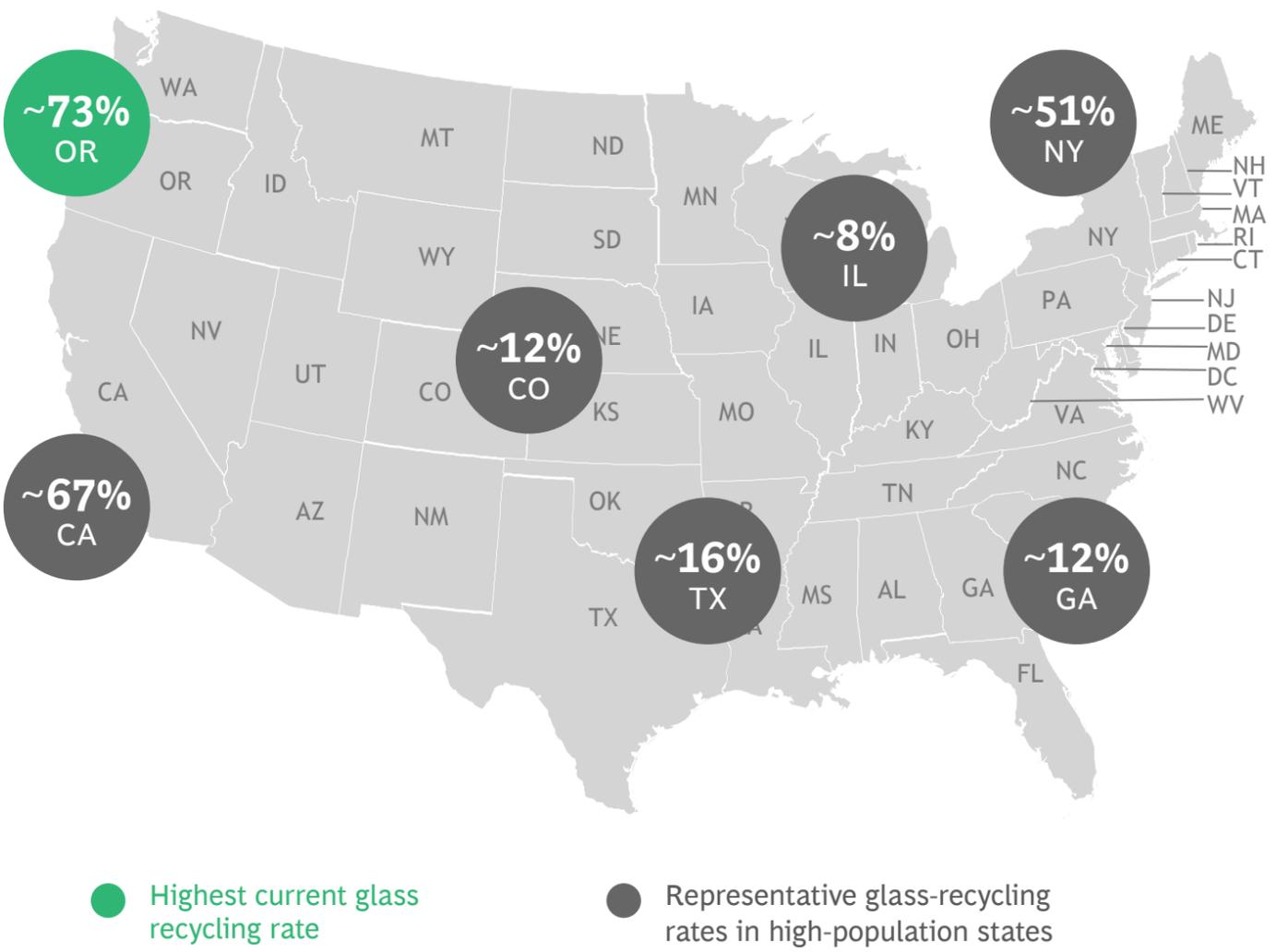
Achieving a **50% glass recycling rate** reduces greenhouse gas emissions by **~1.4M metric tons annually**



The equivalent of taking **~300K cars off** the road each year



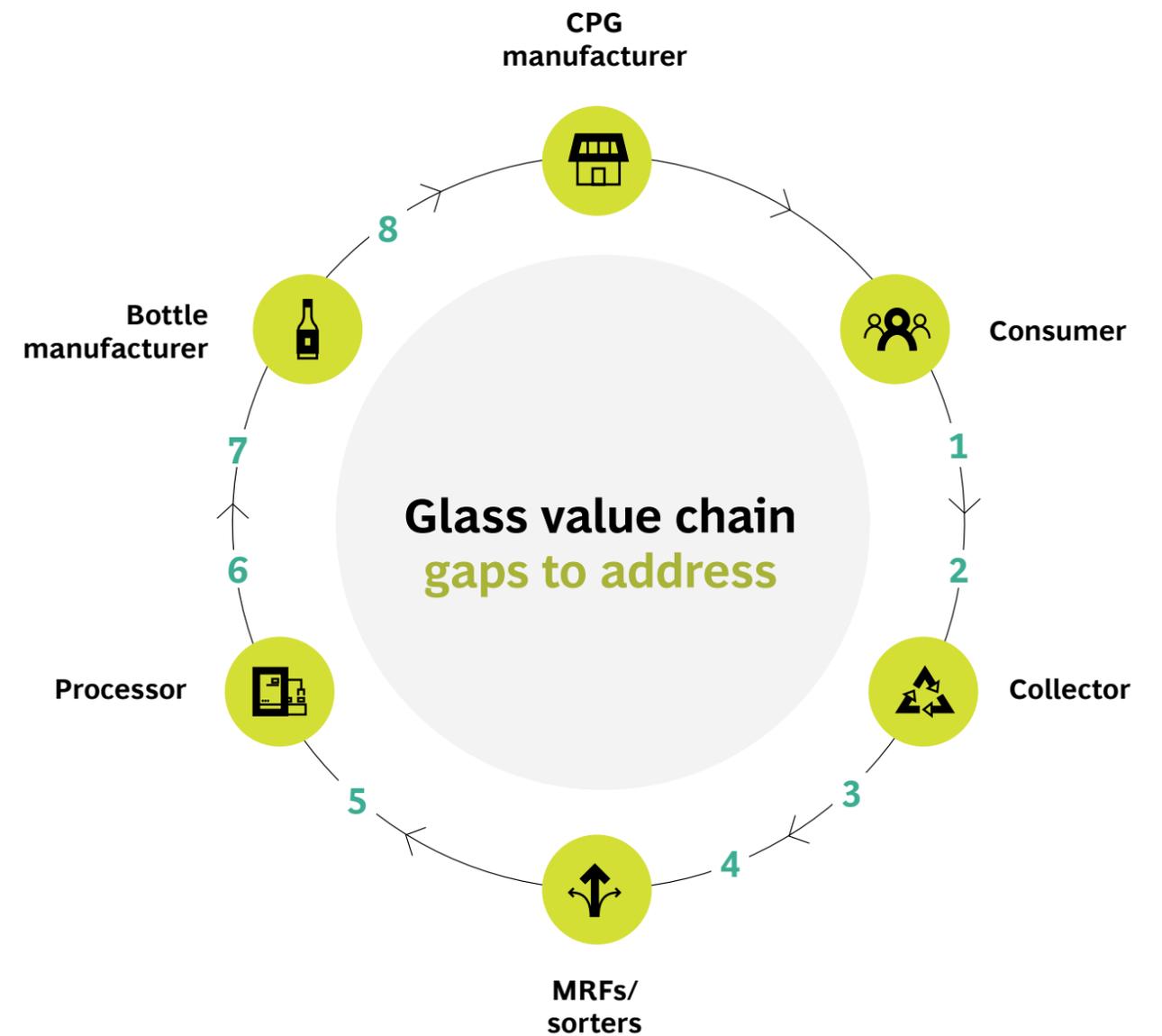
The industry's goal is ambitious given the current status of glass recycling across the US



Sources: GPI; Container Recycling Institute; Resource Recycling; US Environmental Protection Agency; BCG.

Glass container recycling faces multiple challenges in the US today

- 1 Consumers lack the incentive to recycle if inconvenient; opt-in and subscription models lead to low participation
- 2 Rising materials recovery facility fees (\$100+/ton) and pressure from the waste management industry have caused some municipalities to remove glass from curbside recycling
- 3 The lack of recycling mandates and high levels of contamination cause a significant portion of materials to be disposed of in landfills
- 4 Low landfill tip fees for many MRFs (as low as \$9/ton) incentivize sending glass to the landfill
- 5 The lack of capacity in certain areas hinders the ability to meet the market demand and reduces the incentive to invest in materials recovery facilities
- 6 In some regions, strong demand for cullet from other end markets reduces potential supply for glass containers
- 7 The distance between the sources of and markets for cullet requires long-haul shipping, sometimes over 200 miles
- 8 Virgin materials are often cheaper than cullet, sometimes by as much as 20%



Local requirements and conditions prevent a “one size fits all” approach

But select efforts in the US and abroad have proven **success is possible with bold action**



The NY bottle bill increased the recycling rate to

2x the national average

and expanding the bill to include wine and spirits would increase their recycling rate by 65%



Glass end markets and a local brewery collaborated with Ripple Glass to increase the rate of recycling in the Kansas City metropolitan area by

7x since 2009

which is still growing



In Colorado, collaboration along the value chain has increased recyclable glass by

4x the previous rate

with a goal of 50%+



In the UK, the glass recovery rate increased 39 percentage points between 1996 and 2010

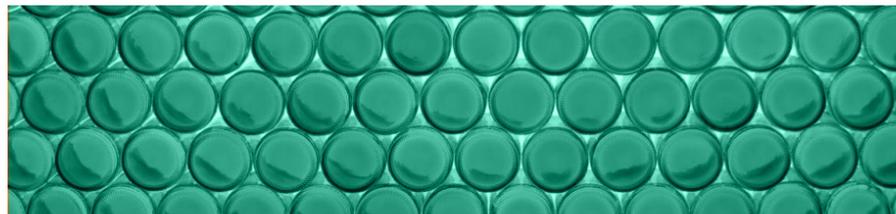
3x increase

from 22% to 61%

Three key pillars ensure every glass bottle has a path to recovery

1

Leave no bottle behind



Ensure consumers have a way to recycle every glass bottle at a cost lower than waste disposal

2

Transform the recycling system



Develop infrastructure that is capable of economically sorting, processing, and transporting glass to manufacturing sites

3

Drive collective action

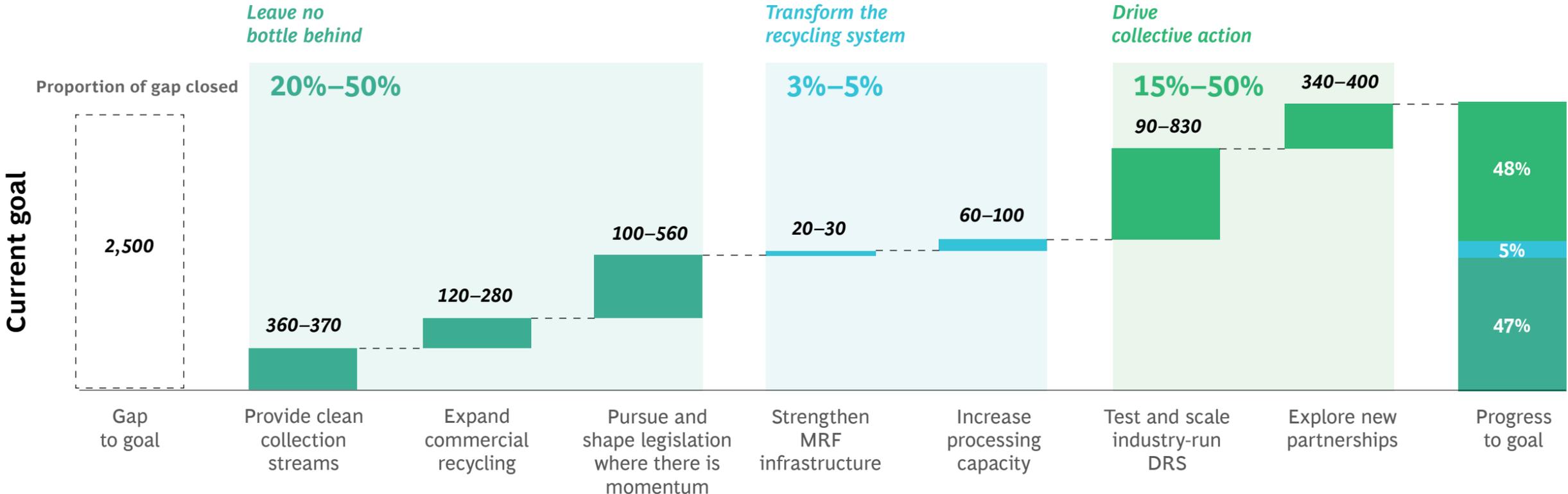


Identify collaboration opportunities between the private and public sectors to forge a nationwide commitment to solve the recycling challenge

Seven levers can help the US achieve a 50% recycling goal

Familiar solutions only get the country halfway; private sector collective action can close the gap

Incremental cullet (thousands of metric tons) generated annually by suggested solutions in selected states



Sources: GPI; BCG.
 Note: Projections would increase if more states adopted these measures. DRS = deposit return scheme. MRF = materials recovery facility.



Provide clean collection streams

Challenge

Challenge: Glass is removed from curbside recycling due to contamination of other recyclables and high costs

Solution: Where possible, maintain and expand glass in curbside recycling; otherwise, build clean collection options to prevent contamination and increase yield

Resources required

Costs vary by geography but capex is required to cover collection bins and opex to cover collection and transportation costs

Coinvestment from state or local governments as well as foundations

Example geographies

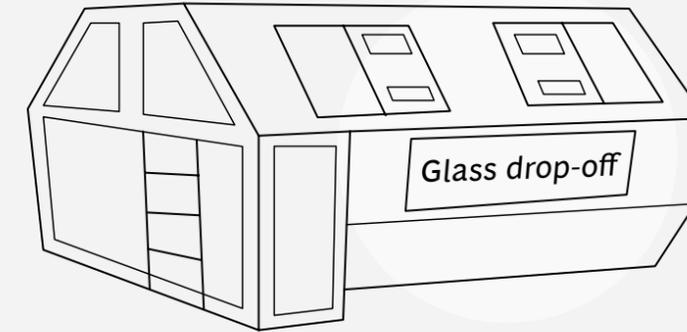
Greensboro, NC
Harrisburg, PA
Pittsburgh, PA

Expected impact

360K to 370K tons of additional cullet through expanded drop-offs; free glass-only curbside collection offered by private organizations or separate bottle collection

Leave no bottle behind

Where possible, maintain and expand glass in curbside collection. When glass is not accepted in curbside recycling, provide clean collection options by expanding glass-only drop-offs or providing free, glass-only curbside collection run by private organizations. Explore hub-and-spoke models for surrounding areas



Several communities offer large drop-offs and glass-only curbside pick-up in geographies that do not accept glass in residential recycling programs



New recycling business models provide a convenient way for consumers to redeem containers by scanning bar codes and dropping off bags; this model could be applied to glass-only collection



Expand commercial recycling

Challenge

Challenge: Low collection rates, as consumers and establishments are often unwilling to recycle when inconvenient

Solution: Capture large centralized deposits of glass at the consumption site

Resources required

Costs commercial businesses ~\$120 monthly to recycle¹

Example geographies

Illinois
Texas
Virginia

Expected impact²

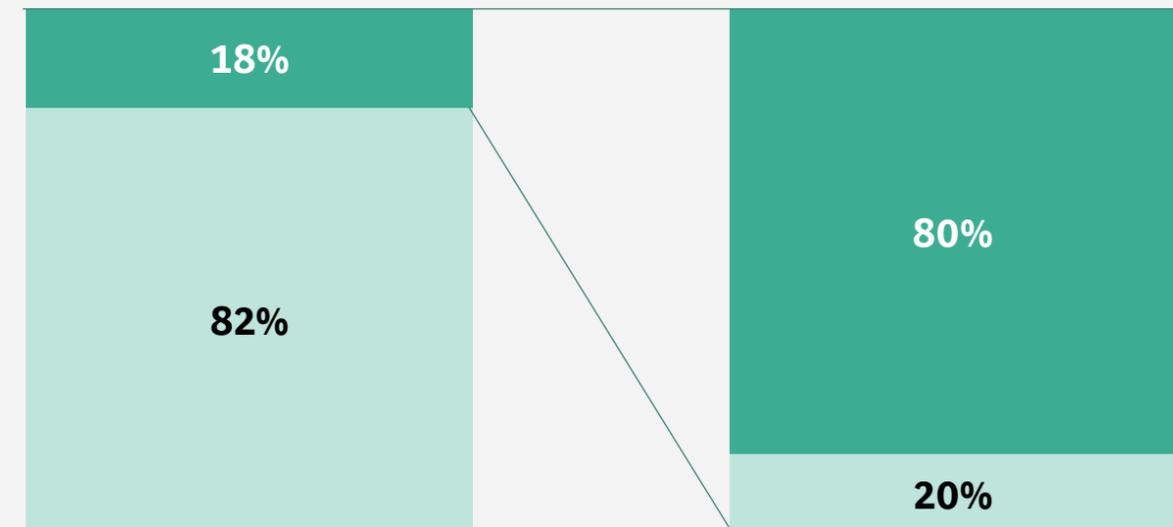
120K to 280K tons of additional cullet from commercial recycling in bars and restaurants

Leave no bottle behind

Encourage expansion of commercial recycling programs to increase glass collection rates from bars and restaurants

18% of all beverages are consumed in bars and restaurants

...and glass makes up 80% of that container mix



■ % consumed on premise
■ % not consumed on premise

■ % made up of glass
■ % not made up of glass

Sources: GPI; BCG.

¹ Based on an average of case studies from the North Carolina Department of Environmental Quality.

² Based on example priority geographies.



Pursue and shape legislation where there is momentum

Challenge

Challenge: Low collection rates, as consumers are often unwilling to recycle when it is inconvenient

Solution: Create a deposit requirement to incentivize collection

Resources required

Discussion with other industry participants, such as wholesalers, to gather support

Example geographies

Maine
New York
Washington

Expected impact¹

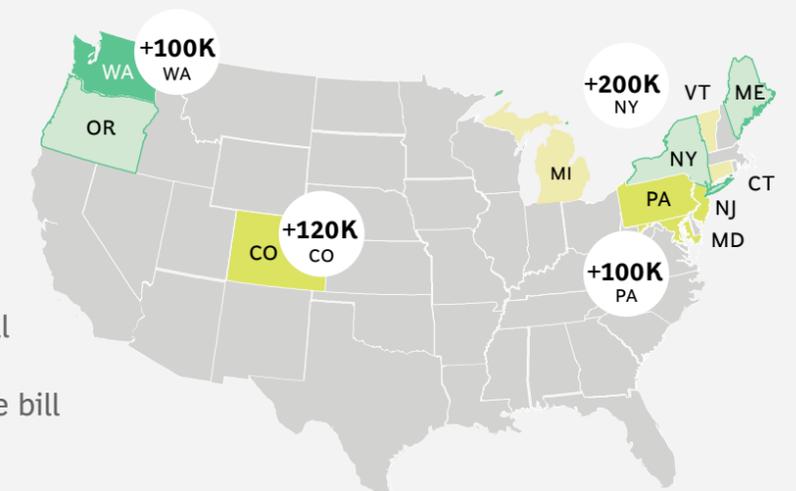
100K to 560K tons of additional cullet from bottle bills and similar legislation passed in key geographies

Leave no bottle behind

Work with local and state legislators to encourage and shape bottle bill expansion to include more types of glass packaging while also looking for greenfield markets where new legislation could be passed

Potential geographies to pursue new or expanded bottle-bill legislation

- High likelihood of expansion
- High likelihood of a new bottle bill
- Medium likelihood of expansion
- Medium likelihood of a new bottle bill



63%

average glass container recycling rate in bottle-bill states

VS.

24%

average glass container recycling rate in non-bottle-bill states

Sources: GPI; BCG.
¹ Based on priority geographies.



Strengthen MRF infrastructure

Challenge

Challenge: High contamination rates and low glass prices have incentivized MRFs to landfill glass

Solution:

MRF technology can increase yields; look for opportunities to increase landfill tip fees

Resources required

~\$600K per MRF in capex investments¹

Minimal or positive impact on opex

Potential for coinvestment from state and local governments and funds like Closed Loop Partners

Example geographies

Atlanta, GA

Charlotte, NC

Philadelphia, PA

Expected impact²

20K to 30K tons of additional cullet from MRF technology upgrades

Sources: GPI; BCG.

Note: MRF = materials recovery facility.

¹ Based on expert interviews and assuming investment would cover two out of three basic upgrades for glass cleaning (including glass breakers, air knives, and a trommel system or vibratory screen).

² Based on example priority geographies.

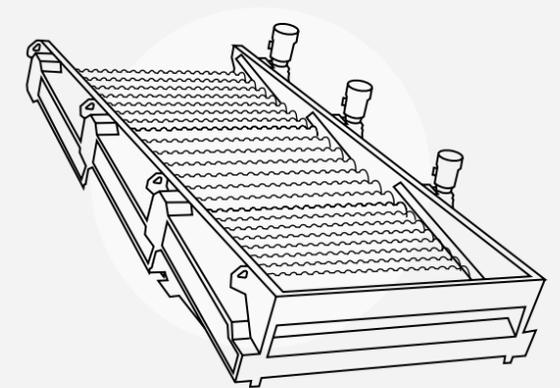
Transform the recycling system

In order to increase yield rates, invest in MRF technology improvements in key metropolitan areas where MRFs are limiting system throughput due to misaligned incentives, poor sorting technology, and other issues

MRF technology example

Description

A glass-breaker screen separates glass from other recyclable materials commingled in a single stream; this can remove glass from the stream early in the sorting process to prevent glass from contaminating other materials, damaging equipment, and causing unwanted issues



Impact

Increases glass yield and decreases contaminants in end product, preserving maximum value of the material; impact further improved when paired with additional technology, such as a fines screen



Increase processing capacity

Challenge

Challenge: Lack of processing capacity incentivizes MRFs to landfill glass rather than send to far-away processors

Solution: The presence of a nearby processor would align economics

Resources required

~\$11M required in capex to set up a processor¹

Opex varies based on several factors, such as population density, contamination, landfill costs, and proximity to end markets

Generate ~\$90/ton in revenue from material sale²

Can be financed through joint ventures or long-term contracts

Sources: GPI; BCG.

Note: MRF = materials recovery facility.

¹ Based on expert interviews; opex can range from \$35/ton to \$50/ton.

² Based on national industry averages from 2018 to 2020; price can differ by the color of glass and region.

³ Based on example priority geographies.

Example geographies

Washington, D.C.

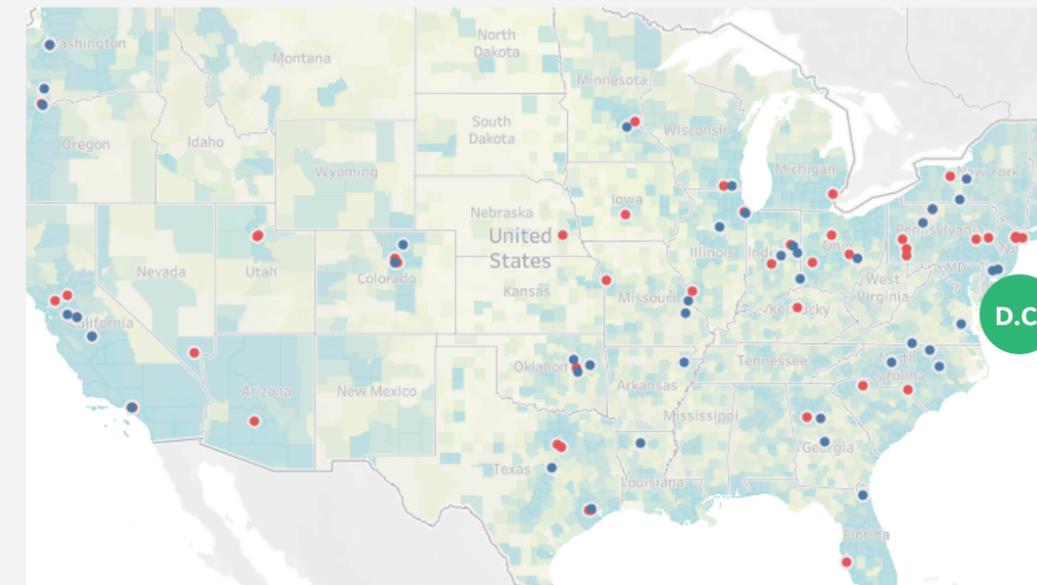
Expected impact³

60K to 100K tons of additional cullet from building processors (likely incremental cullet from other solutions implemented in parallel)

Transform the recycling system

Build processing capabilities by forming a joint venture, vertically integrating a new processor, or supporting a new entrant through long-term contracts to create an end market near high-population areas

Example gap in processing capacity with potential cullet upside



● Manufacturer

● Processor



Test and scale industry-run deposit return schemes

Challenge

Challenge: Low collection rates, as consumers are often unwilling to recycle when not economical

Solution: Encourage the private sector to shape deposit return schemes and incentivize collection

Resources required

Capex for reverse vending machines (RVMs) and collection bins (about \$35 million in WA)

Opex to cover labor, handling fees, transportation, and other costs

Potential for coinvestment from private industry, foundations, and local governments

Example geographies

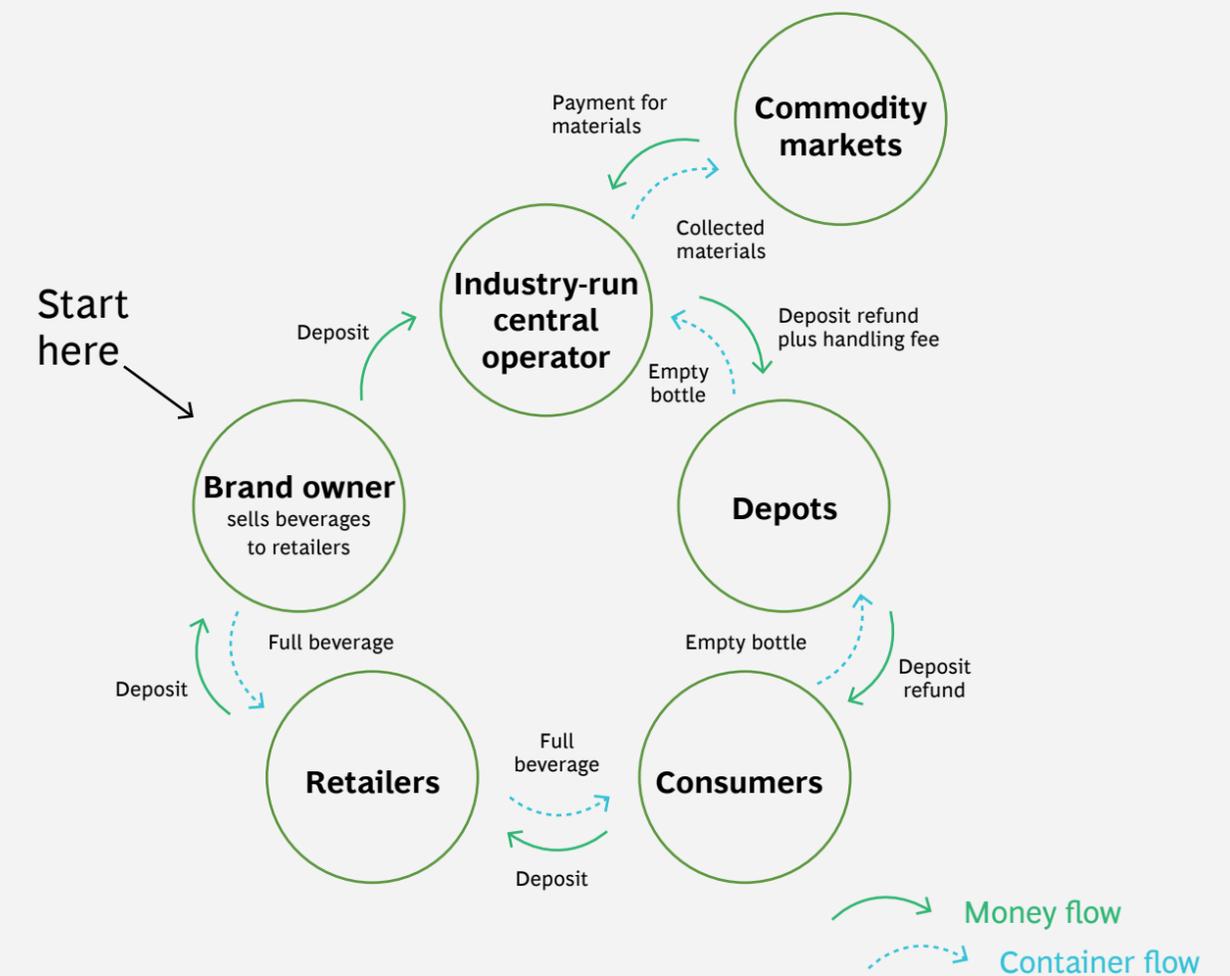
Maryland
New Jersey
Washington

Expected impact

90K to 830K tons of cullet from implementing industry-run deposit return schemes

Drive collective action

Partner with CPG companies, retailers, and other manufacturers across the value chain to set up private-sector-run deposit return schemes for glass, plastics, and other materials





Explore new partnerships

Drive collective action

~340KT to ~400KT
of additional cullet from
innovative partnerships



Create transparency and share information

Increase awareness of state and organization recycling performance

Annual nationwide ranking of states' friendliness toward recycling

Recycling-focused NGOs and foundations (e.g., Ellen MacArthur Foundation)



Leverage advocacy to drive ambition

Partner with advocacy groups to drive ambition, educate consumers, and bring in funding

Partner on circularity in the same vein as Bloomberg Philanthropies' initiative against gun violence

NGOs/foundations driving environmentalism and sustainability (e.g., World Wildlife Fund)



Help brands win on sustainability

Partner with brands to further the recycling agenda and collectively hit sustainability targets

Establish glass-recycled-content target commitments for CPG companies

Beverage producers (e.g., beer, wine, and spirits)



Develop consumer rewards

Create unique and exciting consumer rewards to incentivize recycling participation

Frequent flyer or loyalty program rewards if consumers sign up for curbside recycling

Airlines, hotels, and credit card companies



Increase access to collection points

Public and private partnerships to make recycling the universal default option for disposal

Deposit centers in vacant retail; reverse vending machines in public parks; recycling programs at every hotel property

Municipal waste management departments (e.g., New York City Department of Sanitation), and large retailers and hotel chains



Develop a private sector collection solution

Increase recycling rates by creating industry-run programs providing consumer incentives

Industry-run deposit return schemes inclusive of major container materials, such as plastic and aluminum

Beverage producers (e.g., beer, wine, and spirits), larger retailers, and collection infrastructure manufacturers (e.g., TOMRA)

Sources: GPI; BCG.

Note: Each lever's impact was sized individually, not in tandem with other levers. KT = kilotons.

Parallel processes across levers enable execution of the ten-year goal

Impact in first 2 years

200KT to 400KT incremental cullet annually

\$5M–\$15M capex investment required

IMMEDIATE STEPS



Leave no bottle behind	Provide clean collection streams	Roll out in Greensboro, Harrisburg, and Pittsburgh	Roll out in remaining two to five large metropolitan areas without glass recycling	Monitor for other large metropolitan areas attempting to exclude glass; ensure glass continues to get recycled via advocacy or glass-only recycling programs
	Expand commercial recycling	Share benefits and promote voluntary commercial recycling programs	Pass legislation in two to three states, such as Texas, Illinois, and Virginia	Pass mandatory recycling legislation in an additional five to eight states
	Pursue and shape legislation where there is momentum	New/expanded bottle bill in three states; prepare for next wave	New/expanded bottle bill in two states; prepare for next wave	New/expanded bottle bill in one to three states; target high volume states with little movement today
Transform the recycling system	Strengthen MRF infrastructure	Invest in MRFs in the Atlanta, Charlotte, and Philadelphia metropolitan areas, where the lack of sorting technology is limiting throughput	Invest in MRFs in Virginia and Washington, D.C., as needed for new processors	Monitor US for additional MRFs disrupting throughput and assess need for MRF investment
	Increase processing capacity	Lay groundwork for new processor	Construct new processor in Washington, D.C.	In parallel with other interdependent solutions, build processors in additional areas with high glass generation, inadequate processing capacity, and close proximity to end markets
Drive collective action	Test and scale industry-run deposit return schemes	Select state for pilot, lay groundwork for implementation, and design pilot	Pilot in one state and expand to a second; prepare for next wave of states	Leverage results and learnings to roll out in additional three states
	Explore new partnerships	Exploratory conversations with CPG companies and NGOs; execute transparency partnerships	Publicly join with advocacy partner; expand consumer incentives for recycling	Partner with hotel chains to capture glass consumed on-site; monitor for additional partnership opportunities

Sources: GPI; BCG.
 Note: KT = kiloton. DRS = deposit return scheme. MRF = materials recovery facility.

It is critical to **engage stakeholders** and partners in this long-term effort...

		Key messages	Next steps
	Government	Create jobs through increased recycling practices	Meet with states receptive to bottle bills, EPR measures, and mandatory commercial recycling Lay the groundwork for new processors
	CPG companies and retailers	Drive sales through the enhancement of brand value and manage risk through penalty avoidance	Participate in exploratory conversations with CPG companies and retailers to discuss partnerships
	Investors	Seize the opportunity to differentiate by championing circularity	Build or join a cross-material consortium Foster relationships with foundations to advocate for circularity
	NGOs and coalitions	Becoming a leader in circularity initiatives	Search for advocacy groups to partner with on transparency metrics

...and leverage growing tailwinds to accelerate change



Government regulators are increasing their environmental focus

69%

increase in proposed bills concerning environmental protections since 2012



CPG companies and retailers are announcing ambitious sustainability goals

250+

businesses committed to minimum recycled content in packaging materials



Investors are directing capital to companies focused on sustainable practices

91%

of sustainable investments in 2018 met or exceeded performance expectations



NGOs and coalitions are targeting plastic to drive sustainability, allowing glass to be a differentiator

2x

the international plastic waste initiatives in the last five years

Glossary

Bottle bill	Legislation that mandates a deposit for single-use beverage containers and provides recycling programs to support container return
Consumer packaged goods (CPG)	Products that are sold and consumed quickly (e.g., food, beverages). Used in this document to refer to companies that produce such products
Cullet	Recycled glass that has been processed, crushed, and is ready to be reused in new glass products
Deposit return scheme (DRS)	A system that charges consumers a deposit when purchasing a beverage container, incentivizing them to return it for recycling through issuing a rebate upon return
Extended producer responsibility (EPR)	A waste reduction strategy that requires producers to bear responsibility for the environmental impact of the products they produce
Glass recovery rate	Percent of consumed glass that is collected back to be recycled, which may still be landfilled for various reasons
Glass recycling rate	Percent of consumed glass that is processed into cullet and used in the manufacture of new containers
Landfill tip fee	Cost per ton charged by landfills for dumping waste at sites

Materials recovery facility (MRF)	A waste-processing facility that receives commingled materials and then uses a combination of equipment and manual labor to separate materials in preparation for shipment to processors
Nongovernmental organization (NGO)	An organization operated independently of government involvement, typically a nonprofit, that often serves to address environmental, social, and humanitarian issues
Reverse vending machines (RVM)	A machine that accepts empty drink containers and returns deposit money to consumer; most commonly used to support DRS systems
Yield Rate	Percent of glass recovered that is retained along the recycling value chain and manufactured into new containers; yield loss refers to glass that is lost in the recycling process after collection (e.g., to a landfill)